

REMARKS

Claims 1 – 28 have been examined. Claims 1 – 15, 17, 18, 20 – 24, 26, and 27 stand rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Pat. No. 6,846,745 (“Papasouliotis '745”) in view of U.S. Pat. No. 5,756,402 (“Jimbo”); and Claims 16, 19, 25, and 28 stand rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Pat. No. 6,794,290 (“Papasouliotis '290”).

Independent Claims 1 and 26 have been amended to recite that the film is a silicate glass film; independent Claim 20 already included such a recitation. As the application notes, a “silicate glass” film is a doped or undoped silicon oxide film (Application, p. 7, ll. 3 – 14).

The primary reference, Papasouliotis '745 is cited for its disclosure of aspects of a conventional dep/etch/dep process in gapfill applications. Previous responses to Office Actions have noted that Papasouliotis '745 does not disclose the use of a hydrogen precursor during the etching phase of such processes with the recited flow rate. The Office Action relies on the disclosure of Jimbo for such a disclosure.

But Jimbo is directed to etching a silicon nitride film, not for etching a silicate glass film. Applicants respectfully disagree with the assertion in the Office Action that Jimbo “teach[es] etching a silicon nitride film or silicon oxide film” (Office Action, p. 6, emphasis added). Reference to a silicon oxide film in the portion of Jimbo cited (Jimbo, Col. 2, ll. 4 – 6) is made in identifying part of the (substantially unetched) substrate, not to a structure that is etched by the technique described. In its detailed description, Jimbo makes clear a number of times that the process it describes is selective in etching silicon nitride without substantial etching of any silicon oxide film that might be present.

Specifically, Jimbo describes a process in which a combination of certain flow rates of precursors that provide fluorine, oxygen, and hydrogen result in three reactions taking place: a first reaction in which a silicon oxide film is formed by oxidation of a silicon substrate by oxygen radicals; a second reaction in which the silicon oxide film is etched by hydrogen fluoride; and a third reaction in which the silicon nitride is etched by fluorine radicals (Jimbo, Col. 4, ll. 11 – 20). The first two reactions are approximately balanced so that a net etching of silicon nitride is achieved without significant effect on a silicon oxide film.

This process is illustrated, for example, in Fig. 3 of Jimbo, which provides a plot of the etching rate achieved of different materials with specified flow rates of a fluorine precursor and a hydrogen precursor. While a substantial etch rate is achieved on Si_3N_4 , the etch rate of SiO_2 is substantially zero (*see also*, Jimbo, Col. 5, ll. 65 – 67, which notes that the etch rate at 45°C , i.e. where the etch rate of Si_3N_4 is maximized, is “substantially 0”). Jimbo also notes that at higher temperatures, i.e. at temperatures above 45°C , the formation of SiO_2 is enhanced, resulting in the “silicon oxide film formed on the Si_3N_4 substrate serv[ing] as an etching-resistant film [that] prevents Si_3N_4 from being etched” (Jimbo, Col. 6, ll. 30 – 43).

Independent Claim 1 of the current application recites the use of a halogen precursor, a hydrogen precursor, and an oxygen precursor, but for etching a silicate glass film. The teaching of Jimbo is that the flow rates identified as relevant by the Office Action avoid etching of a silicon oxide film and therefore teach directly away from the claimed use to etch a silicate glass film. Such a direct teaching away is strong evidence against the proposed combination. Stated differently, a person of skill in the art considering modifications of the Papasouliotis '745 process to etch silicon oxide as part of a dep/etch/dep process would have no motivation to implement the process of Jimbo since that reference suggests that its process conditions are ineffective to achieve such etching.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 303-571-4000.

Respectfully submitted,

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